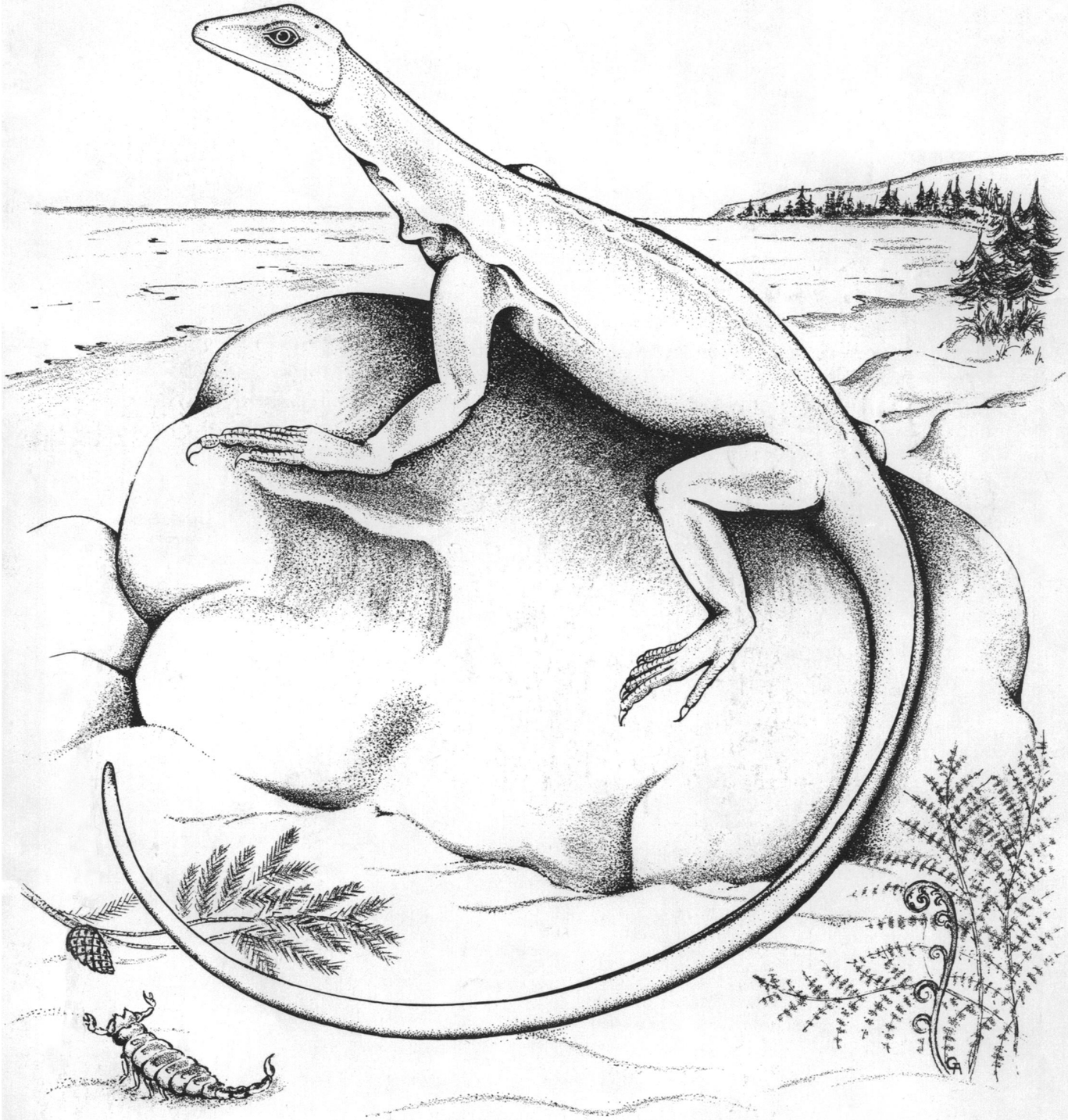
SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

3 June 1977, Volume 196, No. 4294



3 June 1977

Volume 196, No. 4294

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with **The Scientific Monthly®**. Second-class postage paid at Washington, D.C., and additional entry. Member rates on request. Annual subscriptions $60; foreign postage: Canada $10; other surface $13; air-surface via Amsterdam $30. Single copies $2 (back issues $3) except **Guide to Scientific Instruments** $6. School year subscriptions: 9 months $45; 10 months $50. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. **Postmaster: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005.** ***Science*** is indexed in the **Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Reconstruction of the fossil reptile, *Petrolacosaurus*. Accidental deaths in or near a river resulted in rafting of numerous carcasses of reptiles to a quiet marine embayment. Thus, the brackish water Rock Lake desposits near Garnett, Kansas, supply a unique picture to an important chapter in the history of reptiles. See page 1091. [Drawn by Mrs. G. Anderson]

LETTERS

Holography and Image Display in X-ray Crystallography

One cannot but agree with Carroll K. Johnson (Letters, 29 Apr., p. 478) concerning the need for crystallographers to continue working on improving solutions to the "phase problem," as required in x-ray crystallography. It is likely, moreover, that holography (*1, 2*) may make a contribution to this problem as well (*2–4*).

Our efforts at this time, however, are directed at another equally important problem in crystallography, namely, that of *displaying* the reconstructed structures, once computed, in three dimensions (*5–7*). Holography (*1, 2*), with its well-known three-dimensional display capabilities in many domains of science from electron microscopy to ultrasonic imaging (*8*), has now been proved through this work (*5–7*) to have a most promising potential also in crystallography and one which is widely considered by many crystallographers to be worthy of further investigation (*7*). A very effective approach, we find, is the use of opto-digital (holographic) computing (*6, 7, 9*), for which we have developed a new type of digital hologram (*7*). Holographic computing combines the most effective steps in digital and optical computing, respectively, through reconstruction of images in sections of the structure. It is now also possible to obtain images of the structure of the entire molecule in three dimensions, with atoms appearing as diffuse sources, through superposition holography (*2*) by a two-dimensional optical Fourier transformation from digitally computed "Fourier-domain projection holograms" (*7, 8*). This technique shows promise of solving the "feature extraction" pattern-recognition problems that have long plagued crystallographers, who heretofore had available only electron-density maps (rather than images) of such sections.

GEORGE W. STROKE
MAURICE HALIOUA
V. SRINIVASAN

Electro-Optical Sciences Laboratory, Department of Electrical Sciences, State University of New York, Stony Brook

References and Notes

1. D. Gabor, W. E. Kock, G. W. Stroke, *Science* **173**, 11 (1971).
2. G. W. Stroke, *An Introduction to Coherent Optics and Holography* (Plenum, New York, ed. 2, 1969).
3. P. Tollin, P. Main, M. G. Rossmann, G. W. Stroke, R. C. Restrick, *Nature (London)* **209**, 603 (1966).
4. G. W. Stroke, in *X-Ray Optics and Microanalysis*, R. Castaing, Ed. (Hermann, Paris, 1965).
5. _____ and M. Halioua, *Trans. Am. Crystallog. Assoc.* **12**, 27 (1976).
6. _____, F. Thon, D. Willasch, *Proc. IEEE* **65**, 39 (1977).
7. G. W. Stroke, M. Halioua, R. Sarma, V. Srinivasan, *ibid.*, p. 589.
8. G. Baum and G. W. Stroke, *Science* **189**, 994 (1975). (In general the film is maintained in a stationary position during the recording by successive exposure of the component holograms in the single plate.)
9. G. W. Stroke, *IEEE Spectrum* **9**, 24 (1972).

10. Supported by NSF grant MCS-76-11010. G.W.S. acknowledges the many kind and fruitful suggestions from J. R. Pasta and J. B. Kinsinger, as well as from C. N. Yang.

Soil Conservation

I read with interest Luther J. Carter's article "Soil erosion: The problem persists despite billions spent on it" (News and Comment, 22 Apr., p. 409). However, he fails to mention an opportunity for correcting the situation at low cost.

Since a decline in a national food supply normally raises prices more than proportionately (barring burdensome surpluses), and since the elimination of water pollution caused by soil erosion would mean at least some shifts from high-yielding, intertilled crops to lower-yielding small grains, grasses, and forests, a truly effective soil conservation program would increase farm receipts while reducing farm expenses. If this fact could be convincingly conveyed to farmers, they might agree that it is not even to their short-term advantage, collectively, to oppose such a program.

To convey this idea would require a significant turnabout by the educational agencies that normally reach farmers. These agencies, to gain the rapid acceptance of new technology that reduces the cost of food, have stressed to farmers the importance of increasing productivity as a means of ensuring individual survival in the competitive struggle. In doing this they have imparted to farmers a knee-jerk opposition to anything that reduces production or that increases costs.

It has been my experience that farmers are at first suspicious but may soon begin to start thinking about the possibility that they might benefit even from an action as extreme as outlawing the manufacture and use of fertilizer. I am confident that a concerted educational effort could gain their acceptance of strong conservation measures if they knew that they were to be applied nationwide and backed up by embargos on foods produced with exploitive techniques elsewhere in the world, and if assurances were given that

an agency would be formed to equalize the resulting benefits among all farmers.

A soil conservation program supported by farmers would be much more effective and less costly in tax dollars than one imposed on them by a police force.

HOWARD E. CONKLIN
Department of Agricultural Economics, Cornell University, Ithaca, New York 14853

Btu Borrowing?

I have a modest proposal which might settle the controversy about energy analysis and the "net energy" concept involving Malcolm Slesser, Howard T. Odum, and David Huettner (Letters, 11 Apr., p. 259). Instead of paying for imported oil in dollars, let us borrow Btu's from Saudi Arabia and pay them back in Btu's some years from now, after fusion power or some other essentially inexhaustible source of energy has been developed—with interest of course. If they accept this proposal, then we can consider the controversy settled in favor of net energy accounting.

S. FRED SINGER
Department of Environmental Sciences, University of Virginia, Charlottesville 22903

"Kerfuffle"

Is Nicholas Wade, who writes so succinctly about techniques of gene splicing with recombinant DNA molecules (25 Feb., p. 762), practicing analogous techniques of syllable splicing and recombinant "verbarianism" when he speaks of a regulatory "kerfuffle"?

Presumably a kerfuffle is something like the brouhaha which he mentions earlier, but I could not find the word in any regular or slang dictionary. F. B. Hilmer (personal communication) suggests that Wade has grafted the prefix "ker-" to "fuffle" (to put, or be, in disorder), as in kerplop, kersplash, and so forth. But we doubt that he has a valid hybrid because (i) it is not onomatopoeic, and (ii) it is used as a noun, whereas the precedents are usually adverbs.

Perhaps we also need guidelines for this kind of recombinant research, else we shall soon encounter such hybrids as "broufuffle" and "kerhaha."

FRANK M. MCMILLAN
5285 Windsor Boulevard, Cambria, California 93428

THE FUTURE IS HERE

are you ready for it?

Avoiding future shock - being ready for the prospect that tiny integrated circuits like the one shown here will increasingly govern the way you work, play, and interact with the world around you - is a major goal of the new AAAS compendium, ELECTRONICS: THE CONTINUING REVOLUTION. It is not necessary to understand the technology of an integrated circuit in detail to be aware that their decreasing costs and growing power are spearheading the continuing revolution. And integrated circuits are only a part of the technology that is shaping the future of science, business, leisure activity - even cooking appliances. ELECTRONICS: THE CONTINUING REVOLUTION explores the past, present, and potential role of electronics in such diverse areas as banking, medicine, communications, education, defense, employment, and more.

Be ready to take full advantage of the electronic advances that are coming your way. Order your copy of ELECTRONICS now.

ELECTRONICS

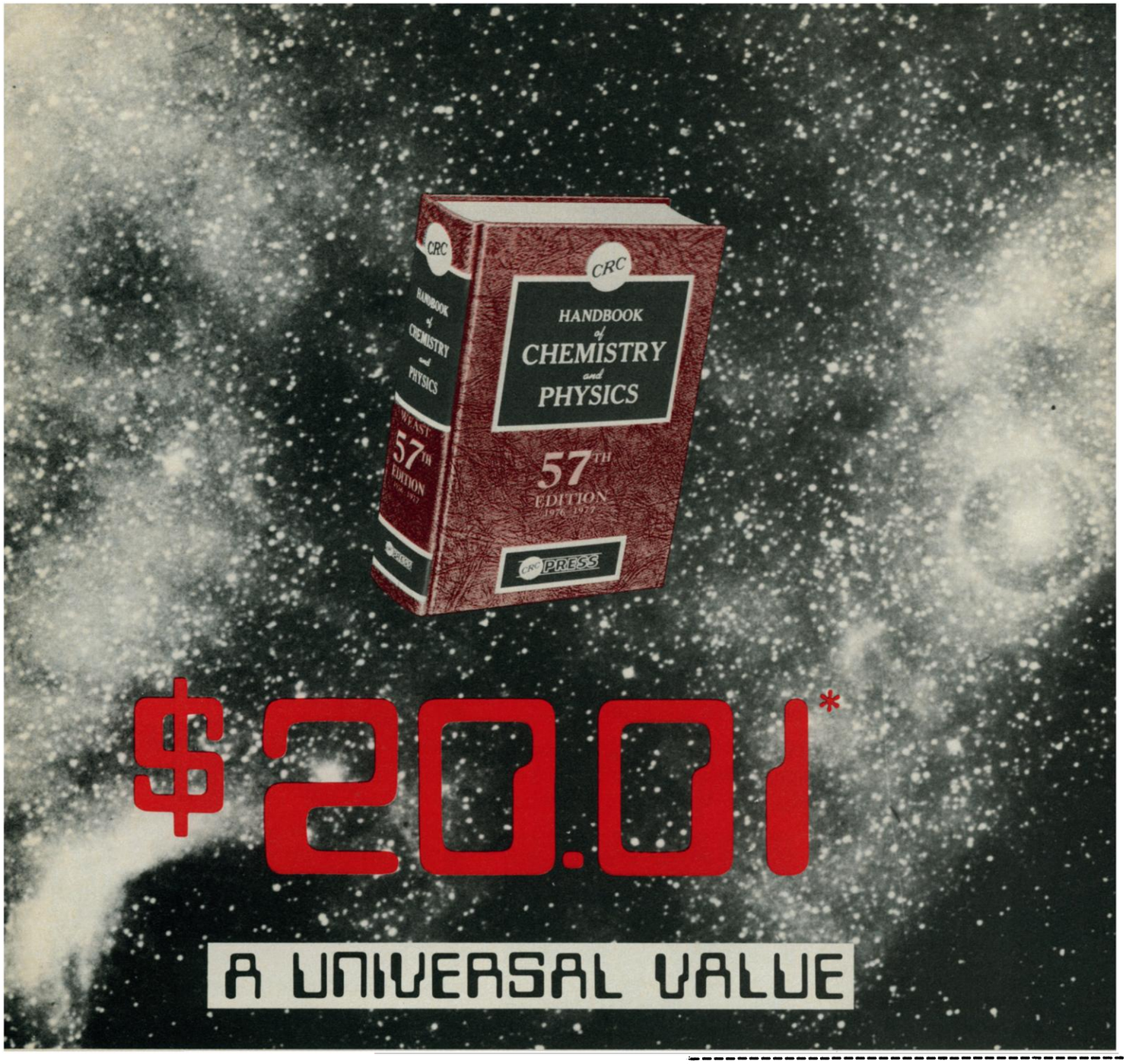
A Glance At The Past — A View Of The Future

Retail: $12.95 Casebound, $4.95 Paperbound.
AAAS Member: $11.95 Casebound, $4.45 Paperbound.
Series and bulk order information upon request.
Please allow 6-8 weeks for delivery.

coming soon from

aaas

To reserve your copy, write to:
American Association for the Advancement of Science
Department D
1515 Massachusetts Avenue, N.W.
Washington, D.C. 20005



Reg. U.S. Price $34.95—SAVE NEARLY 40%

The current edition of the CRC Handbook of Chemistry and Physics is being offered at the special price of $20.01* until June 30, 1977. For a limited time you can save nearly 40% on "... **the desk-top reference for chemical and physical data**" *(Chemistry Magazine)*.

This 57th Edition of the Handbook, referred to by *New Equipment Digest* as "... **a valuable finger-tip reference for anyone involved in any discipline of science**", contains over 2300 pages of pertinent tables, graphs, data, and chemical property information.

Thousands sold at $34.95. Until June 30, 1977 you can purchase this same best-seller for nearly 40% less than the regular retail price. Send your PRE-PAID order to CRC PRESS with the attached order form and special catalog number before June 30, 1977 to take advantage of this special saving.

*(Outside U.S.A. $22.95, Payable in U.S. Currency by Draft or Check on a U.S. Bank.)

You can't afford to wait—DEADLINE: June 30, 1977

ORDER FORM

DATE _____

Please send me the 57th Edition of the CRC Handbook of Chemistry and Physics for $20.01* (Reg U.S. Price $34.95). To qualify for this special offer:

- Cite Catalog No. 457K NH when ordering
- All orders must be prepaid and placed directly with CRC Press

(Postmarked before June 30, 1977) Offer valid only for individuals and/or institutions. Ohio residents add 5.5% sales tax.

Name _____

Title _____

Co./Inst. _____

Address _____

City _____ State _____ Zip _____

*(Outside U.S.A. $22.95. Payable in U.S. Currency by Draft or Check on a U.S. Bank.)

Amount Enclosed $ _____

Sale price covers postage, insurance and handling charges.

CRC PRESS, INC.

18901 Cranwood Parkway,
Cleveland, Ohio, 44128 USA

3 June 1977, Volume 196, Number 4294

SCIENCE

The Blind Side of Science Policy

In the on-again, off-again chronology of the President's Office of Science and Technology Policy there has been at least one consistency: it never has had a voice in the economic policy circles of a President. Unlike other advanced nations, both democratic and authoritarian, the United States has not seen fit to make explicit the role of science and technology in mapping economic strategy. We are likely to regret it.

In last year's presidential race, both Mr. Ford and Mr. Carter were questioned about their positions on government spending for research and development. Mr. Carter thought that both public and private R & D should grow as the economy grows, but that it would be wrong to tie R & D spending to any fixed fraction of any macroeconomic indicator, "for R & D is a microeconomic factor." President Ford argued not that R & D promotes the national economy but that a strong economy is a necessary precondition for science and technology.

These views reflect a consensus of opinion across the otherwise contentious spectrum of our political economy. It would be hard to argue that R & D should drive the national economy. But the absence of *any* explicit R & D component in macroeconomics flags a significant and puzzling flaw in our national policy machinery.

It is conventional wisdom to say that we see science and technology as only parts of a large family of forces which influence the quality of the national economy. We subordinate their roles to more important elements: skilled management, product diversification, market satisfaction, modernization, entrepreneurship, ingenious infrastructure, and career self-selection. If these elements are not in place and working, R & D is insufficient by itself. On the whole, the theisis stands up. The trouble is that while it has served to explain the past, it may not be good enough to produce a future.

America's macroeconomic goals are not hard to capture and describe. They are to maintain a high standard of living, to confine unemployment within a range of 4 or 5 percent of the work force, to secure a favorable international trade balance, to minimize extreme swings of the business cycle, to produce enough to meet demand without inflation, and to generate enough real growth to create the jobs needed for a growing labor force. These are consensus objectives.

But it is noticeable that when the economic script goes wrong, we invariably grab for the emergency cords of money and credit policy, tax policy, and spending policy. It is doubtful that it ever occurred to an economic czar that an explicit public policy to strengthen public and private technological drive would contribute something of value to long-term stabilization and growth.

There are signs that the vitality of growth-producing technological effort in the United States is not what it used to be. In industry, despite the impressive dollars assigned to R & D, the mix of spending has shifted strongly away from innovation and toward defensive research and development. The U.S. economy cannot count on much of a future if this scenario continues, resting content with old beliefs in the strictly *micro*economic role of R & D.

Down at the White House, reorganizers are busy with plans to shape up the sprawling Executive Offices. Someone should be thinking hard about new assumptions as to how the Office of Science and Technology Policy can make a real difference in policy planning. Seen from here, an important difference could be made if the science adviser were linked not only to the President's budgetary staff but also to the Council of Economic Advisers. The time has come to deal with the blind side of science policy.

—WILLIAM D. CAREY

Books you should know about....

....from AAAS

RESEARCH AND DEVELOPMENT IN THE FEDERAL BUDGET: FY 1977

by Willis H. Shapley, for the Committee on Science and Public Policy
Retail $5.50. *AAAS member* (prepaid) $4.95.

How are decisions really made on federal funds for research and development? What important changes are being implemented in the Congressional budget process, and how will they affect future R & D budgets? How was the 1977 Federal Budget prepared, and what may happen to it? Few scientists and engineers know the answers to these crucial questions, even though the future of their projects, their programs and institutions, and even whole fields of science or technology are heavily influenced by government funding for R & D. RESEARCH AND DEVELOPMENT IN THE FEDERAL BUDGET: FY 1977 is a report and commentary by an experienced former budget official. It provides current and authoritative treatment of R & D in the federal budgeting process, with important information for scientists, engineers, research institutions, administrators, and students of public policy. In the changing climate of government support for R & D, this book is essential reading!

SCIENTIFIC FREEDOM AND RESPONSIBILITY

by John T. Edsall, for the Committee on Scientific Freedom and Responsibility
Retail $3.45. *AAAS member* (prepaid) $2.95.

Are *you* concerned with the present and future uses and misuses of science and technology? If so, be sure to read this report. It studies and reports on the conditions required to give scientists and engineers the freedom and responsibility to speak out. It prescribes criteria and procedures for the objective and impartial study of conflicts concerning scientific freedom and responsible scientific conduct. And it encourages the development of mechanisms for resolving such disputes. This cogent and meaningful report deals frankly with the value questions facing the scientific and technical communities and does not straddle the hard ethical choices.

CULTURE AND POPULATION CHANGE

A revised edition by Irene Tinker, Priscilla Reining, Warren Swidler, and William Cousins. Preface by Margaret Mead.
Retail $3.50. *AAAS member* (prepaid) $3.00.

This widely read position paper originally was prepared for the World Population Conference held in Bucharest in August 1974. It examines the cultural factors impinging on population matters and points to the need for governments to integrate such factors into their official population policies. The revised edition has been expanded to include a commentary on the World Population Plan of Action formulated at Bucharest. This is an interesting and informative report for everyone concerned with the complex interactions of culture and population policy.

American Association for the Advancement of Science

Please send me

_____ copy(ies) of **Research and Development in the Federal Budget: FY 1977.** *Retail* $5.50; *AAAS member*, prepaid, $4.95. (1976, 112 pages, paperbound)

_____ copy(ies) of **Scientific Freedom and Responsibility.** *Retail* $3.45; *AAAS member*, prepaid, $2.95. (1975, 64 pages, paperbound)

_____ copy(ies) of **Culture and Population Change.** *Retail* $3.50; *AAAS member*, prepaid, $3.00. (1975, Revised Edition, 80 pages, paperbound)

Bulk Order Rates Available on Request

Remittance must accompany orders under $5.00

☐ Check or money order enclosed (*payable to AAAS*).

☐ Please bill me.

Name _____

Address _____

City _____

State _____ *Zip Code* _____

American Association for the Advancement of Science
Department H
1515 Massachusetts Avenue, N.W.
Washington, D.C. 20005

(Please allow 6–8 weeks for delivery.)